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ALBERT MEDAL.

It may not be generally known to our readers that the Society of Arts Council annually award the Albert Medal to men of high distinction, as a reward for "distinguished merit in promoting Arts, Manufactures, or Commerce." Ten medals have been awarded, of which two have been presented as follows:—

In 1866, to Professor Faraday, D.C.L., F.R.S., for "discoveries in electricity, magnetism, and chemistry, which, in their relation to the industries of the world, have so largely promoted Arts, Manufactures, and Commerce."

In 1867, to Mr. (now Sir) W. Fothergill Cooke and Professor (now Sir) Charles Wheatstone, F.R.S., in "recognition of their joint labours in establishing the first electric telegraph."

The question to whom the medal for 1874 is to be given will be decided next month. The 11th inst. was the latest date up to which the secretary would receive from members of the Society the names of men considered to be worthy of the honour. We trust that another electrician—we refer to Sir William Thomson—a philosopher of "high distinction," may be successfully proposed. The grounds for which we deem him specially worthy are the practical aid he has rendered to submarine telegraphy; his investigations in all branches of the science of electricity and magnetism; and his many other important inventions, notably the quadrant electrometer,

INTERNATIONAL EXHIBITION.

We regret that we cannot speak in high terms of the display of electrical apparatus in this year's Exhibition. The following list comprises the instruments, &c., we have at present noticed:—

Exhibited by Messrs. T. Cooke and Sons.

1. A Motor Clock, which drives, by electricity, the eight large dials in various parts of the building.

Exhibited by Messrs. C. and E. Fern.

2. Electro-Medical Apparatus.
3. Transportable Zinc Charcoal Battery.
4. Two Manganese Balloon Elements.
5. Crank Rheostat.
6. Support for Electrodes with Commutator.

Exhibited by Mr. J. T. Janssen.

7. Guattaris' Atmospheric Telegraphic Instruments.

Exhibited by Messrs. Siebe and Gorman.

8. Electrical Submarine Lamp.

As mentioned in our last number, we shall give a description of those articles which are of sufficient importance to warrant a special notice.

ON THE NEW CONTACT THEORY OF THE GALVANIC CELL.

At the Physical Society, on 21st March, Mr. J. H. Fleming introduced a paper on the above subject, in which he discussed the various opinions respecting the contact and chemical theories. Afterwards Mr. Fleming showed his new battery, in which the metallic contact of dissimilar metals is entirely avoided. The arrangement consists of thirty-six test-tubes of dilute nitric acid, and the same number of tubes of sodium pentasulphide, all well insulated, alternating with one another. But strips of alternate lead and copper connect the neighbouring tubes; by which means the terminals are of similar metal, and a current of sufficient intensity to violently affect a quantity galvanometer obtained. The potential increases, as in the ordinary galvanic arrangement, with the number of cells employed, until sixty cells showed an electromotive force exceeding that of the same number of Daniell's elements. In this new battery the acid lead is *positive* to copper; whilst in the sulphide it is negative. Mr. Fleming further showed how, by using the single fluid nitric acid, and the single metal iron, a similar battery could be constructed, provided one-half of each iron strip was rendered passive. This is an important discovery; for it seems to revive the theory that chemical action is not necessary in a galvanic apparatus to produce electricity. At all events it is of sufficient interest to merit the sound enquiry into its principles which physicists seem likely to make.

ON THE PRINCIPLE OF VOLTA.*

Putting aside the theory of the pile, and without prejudging it, I have proposed to demonstrate the real existence of the electromotive force of contact, independently of all chemical action of the surrounding medium.

Volta made two fundamental experiments:—
1. The experiment with the two plates, zinc and copper; it is explained by chemical action of the liquids moistening the fingers, that is to say, it comes quite naturally into the theory of the pile:
2. The experiment with the insulated zinc plate, placed on the condenser; the chemical action which is here adduced in explanation by M. de la Rive is the action of the surrounding medium. It should be noted that in the former experiment the zinc is charged negatively, and in the second positively. I am in a position to prove—1. That the explanation given by M. de la Rive is inadmissible; and 2. That very distinct signs of electricity are obtained even when the zinc is covered with an insulating layer several millimetres thick.

The apparatus employed in these researches was the induction electrometer. It consists of two brass pulleys, one above another, on a stand, with a caoutchouc tube, which bears 200 small brass rings $5\frac{1}{2}$ m.m. diameter, formed of 1 m.m. wire, passing round them. The caoutchouc tube (half a metre long) is put in motion by the lower and larger pulley (call it B), which receives its motion from a side pulley wrought by the hand. A body, E, (electrified) is held by a support very near the upper and smaller pulley, A, where the rings leave this to go to B. The rings thus move down charged with electricity of contrary sign to that of the electrified body, and they carry it to a conductor, C, which is connected with a very sensitive dry pile electroscope. This conductor is spherical, and has two holes through which the rings pass; that by which they enter is no more than wide enough to let them pass; the other is much wider, nearly 12 m.m. diameter. In this conductor there is a small brass pulley which the rings touch in passing, and thus communicate their electricity to the conductor. As the contact is thus effected at a point of the conductor where the electric density is *nil*, the rings leave it discharged. However small the charge of the body E (placed near the upper pulley), the charge of the spherical conductor increases rapidly, and becomes sufficient to be indicated by the electroscope. It is necessary that the rings and the pulleys be of the same substance, otherwise there is always a small development of electricity even when no electrified body is brought near to the upper pulley.

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* Abstract of a recent paper in the *Journal de Physique*, b rofessor Righi, of Bologna.

The explanation of M. de la Rive, by which that eminent physicist brings the development of electricity in Volta's second experiment into the theory of the pile, is well known. "This disc (of insulated zinc) polarises the molecules of the layer of moisture in contact with the surface as a plate of zinc polarises the molecules of water in which it is immersed. The moment that the zinc is brought into contact with the copper disc of the condenser, a couple is formed, a discharge occurs, the negative electricity passes from the zinc to the copper in contact, the zinc is oxidised, and the positive electricity become free, being unable to flow away (since the medium where it is liberated, instead of being, as in the case of a true voltaic couple, liquid and conducting, is gaseous and insulating) remains at the surface of the zinc, where it is condensed by the negative which has passed into the copper disc." According to M. de la Rive, the copper receives its negative electricity from the zinc, and not from the air; if, then, the copper be covered with gum lac, the same results should be obtained. Now, take a disc of copper 15 centimetres diameter, and on one of its faces, near the edge, solder three zinc wires 3 or 4 m.m. long; cover the copper disc with melted gum lac in such a way that the ends of the three wires are left bare: then put it in contact with a disc of zinc by means of these three wires. If there is a difference of potential between the two metals, they should take opposite charges, which are smaller the further the discs are separate. On bringing the two discs successively (by means of insulating handles) to the electrometer, it is found that they have nearly the same charges as are obtained if the copper is not covered with gum lac.

It is thus indeed true that the copper does not receive its charge from the air. For those who do not accept the theory of contact, it follows that the disc of copper might be replaced by a disc of zinc covered with gum lac. Indeed, according to them, wherein can the zinc covered with resin differ, in this experiment, from an unoxidisable metal? Very well; if the experiment be repeated with two discs, one of zinc in the ordinary state, the other of zinc covered with gum lac, not the least charge will ever be obtained. On the other hand, one might repeat, word for word, the explanation of M. de la Rive, substituting, for the word *copper*, the words *covered zinc*.

In place of coating the metallic discs with resin, they may be immersed in an insulating liquid which has no chemical action on the metal, in such a way that the three small ends of wire of the same nature with the metal with which the immersed disc is put in communication, are a little above the surface of the liquid. The effects are not changed, though the liquids may be in many various ways.

In this same theory of M. de la Rive, one might substitute for copper some metal less attackable than zinc, *e.g.* aluminium. If the experiment be made, the aluminium will be found positive, and the zinc negative; that is to say, that the aluminium behaves as though it were more oxidisable than the zinc; while, on the contrary, it is ascertained that the same discs immersed in water give a current of the same direction, which would be observed if copper were in place of the aluminium.

From these experiments it follows that M. De la Rive's explanation must be rejected.

The existence of the electromotive force of contact being demonstrated, substances may be ranged in such an order that each one is positive with those which follow; we have thus the following list:—Aluminium, zinc, lead, tin, iron, copper, anthracite, silver, pyrites, platinum, gold, battery-charcoal.

Thus, for example, if we place a disc of copper on a disc of charcoal, and afterwards separate them, the copper is found positive and the charcoal negative.

I commence to study the existence of the electromotive force of contact between two bodies of the same nature, but with different temperature; the warm substance is charged negatively. I reserve these facts for another occasion. There is nothing to hinder our supposing that the cause of electricity, of friction, of cleavage, of pressure, &c., is always the force of contact. I may recall, among others, the experiments of M. Gaugain, who has classed the metals according to the sign of electricity they acquire by friction: the list of the French physicist coincides with mine, and, notably, aluminium in it precedes zinc. I may also trace a connection between the well-known fact of the tendency to be electrified negatively, which heat communicates to bodies, and the fact which I have pointed out, of a difference of potential produced by an elevation of temperature.

In this extract I have omitted all details of experiments required to guard against the numerous causes of error naturally presenting themselves in researches so delicate.

THE ELECTRO-DEPOSITION OF METALS.

By J. T. SPRAGUE.

(Continued from page 136.)

THE doctrine of the correlation of forces has taught us that the different forms of energy are interchangeable and convertible: there must, therefore, be a definite relative value. The unit of mechanical energy of work is the foot-pound, that of heat in England is the quantity of heat necessary to raise the temperature of one pound of water 1° Fahrenheit, and the average of many experiments shows that the energy represented by this quantity of heat is equal to 772 foot-pounds; this, then, is called the mechanical equivalent of heat, being the ratio between the heat or work units, and is sometimes named a "Joule" after the philosopher whose work its valuation is. As yet there is no similar mechanical equivalent of electricity adopted, although the materials of the valuation are well known in the form of the heat equivalent to any current. But, in fact, no such equivalent is possible while attention is confined to mere weights; as electricity is related to atoms and valencies, not to pounds, &c., its definite measurement must be linked to atoms and valencies.

Upon this principle I have suggested a unit which is really the mechanical equivalent of electric energy. Taking as the basis the electric equivalent of any chemical reaction as shown in Column VI. of the Table A, page 136, and considering this as effected under the unit electric force, viz. 1 volt, in the unit resistance 1 ohm, the known formula of work shows that energy equivalent to 4673 foot-pounds is expended in maintaining the veber current for 6338 seconds, the time it takes to effect one equivalent of reaction. This (which exactly corresponds to the 772 foot-pounds in its use) I propose to call an equi-volt.

The importance of this unit will be seen at once when it is found that the values given in Columns VII. and VIII. of the Table A, page 136, and similar values for other reactions, when divided by this figure, represent exactly *the electromotive force in volts which that reaction can generate*. On the other hand, whenever we can ascertain the electric tension which any chemical reaction can produce in volts, multiplying by 4673 gives us the mechanical equivalent in foot-pounds of the chemical affinities in play. We are thus furnished with what has never yet been possessed, a definite value for what used to be called "elective affinity." In fact, the equivolt, or its equivalent in the metric system of weights, would really be the natural unit of the correlation of forces, as it brings the merely arbitrary systems of measurement into relation to nature's unit of measurement, the atom.

We shall now be able to see where we obtain electromotive force from, and how to obtain it most cheaply, by a judicious application of these principles. The following Table B gives the mechanical equivalents of the solution of some of the oxides in the common acids, and is necessary to complete the information of the first Table, A.

B. ENERGY OF COMBINATION OF OXIDES AND ACIDS.

Oxide of	Sulphuric Acid.	Nitric Acid.	Hydrochloric Acid.
Ammonium ...	2759	2422	2422
Copper	1533	1271	1274
Iron	2158	1915	1951
Lead	—	1767	—
Potassium... ...	3157	2898	2839
Silver	—	1370	—
Sodium	3216	2779	2918
Zinc	2076	1652	1649

Practically the source of our force in all galvanic batteries is the consumption of zinc, usually in sulphuric acid; this process may be regarded either as zinc entering the acid, or (as it used to be thought) the forming first the oxide of zinc, and then the solution of this in acid; the first is probably the true theory, but we can now use the latter for a single purpose, viz., to ascertain by the two tables the energy corresponding to this process.

A. Zinc in oxygen, ZnO	8427	foot-pounds
B. Zinc oxide dissolved, ZnO,SO_3	2076	"
	10503	"

This is the total energy of formation of zinc sulphate; and divided by the equivolt 4673, it gives us 2·248 volts as the equivalent electromotive force; but in a battery there is always decomposition as well as combination; in the Smee, hydrogen gas is set free or unburnt; in the Daniell, copper, and in the Grove and Bunsen, nitric acid is reduced: every one of these actions absorbs energy; the table gives 6841 as the energy of hydrogen, absorbing, therefore, 1·464 volts, and leaving only 0·784 as the chemical value of any such reaction, but there is still another important element of the battery to consider in order to ascertain the actual value. If we take a salt of silver, say the nitrate, and immerse copper in it, the silver is displaced, and a salt of copper formed; iron in its turn will displace the copper, and zinc the iron; properly arranged, every one of these reactions will constitute a battery of a definite force; and if we measure and add together the forces developed at each stage, the total will be found exactly equal to that which zinc would give at one action while displacing silver. It is therefore usual to draw out tables of metals, each of which is said to be positive to all above it. A glance at the Table A, page 136, will give the reason of this; at each such stage a corresponding surplus of energy is given out beyond that absorbed. We see at once also why zinc or iron dissolve in sulphuric acid, as both give a surplus over the energy absorbed by the hydrogen; on the other hand, copper and silver will not dissolve because there would be a loss of energy; if we supply that by heating the acid, then we may cause these metals also to dissolve.

If we place zinc in sulphuric acid, it tends to decompose it with an energy of 2·248 volts; that is to say, it attracts to that degree the SO_4. the sulphuric radical of the acid H_2SO_4. If we place in the acid a plate of copper, it cannot decompose it, but it obviously must have an attraction for the radical, which may be calculated in the same way as that of zinc. Now, when we place the two metals together in acid, each attracts the radical, and the energy of polarisation (that is to say of electromotive force set up) is the difference between these two attractions. It is obvious, then, that the higher in the series the second metal stands, the less will it resist the zinc, and the greater the electromotive force left available. We thus learn at once that it is exceedingly bad economy to use copper in a battery instead of silver; platinum or carbon would be still better than silver, but for a faculty they possess of collecting upon their surfaces a firmly adhering coat of hydrogen, which thus almost turns the second metal into a surface of hydrogen, with a consequent low force. We have thus three considerations in a battery.

1. The force given out by the positive or dissolving metal.
2. The counter force exerted by the negative metal.
3. The energy absorbed by the chemical decomposition at the negative plate.

The following table, C, gives 1 and 2 expressed in volts:—

C. Electro-motive Force of Metals.

Names.	1. Force as Positives.	2. Counter Force as Negatives.	Nett Force of Positives Opposed to Negatives.			
			Zinc.	Iron.	Copper.	Silver.
Carbon ..	0	0	2·248	1·723	1·280	1·174
Platinum ..	?	0·008	2·240	1·715	1·272	1·166
Silver ..	1·174	0·260	1·988	1·455	1·010	0
Copper ..	1·280	0·506	1·742	1·209	0	—
Iron	1·723	0·809	1·439	0	—	—
Zinc	2·248	0	0	—	—	—

The next table, D, gives element 3, the force absorbed chemically in several common forms:—

D. Force Absorbed in Negative Reactions.

Free hydrogen gas	1·464
Liquid hydrogen	0·881
Nitric acid, fuming	0·284
„ „ Sp. gr. 1·38 ...	0·360
„ „ „ 1·33 ...	0·430
„ „ „ 1·32 ...	0·479
Nitrate of soda and sulphuric acid	0·708
Bichromate of potash	0·343
Copper in Daniell's cell ...	0·506

These figures are the nearest attainable from present knowledge. The force given for iron is, I think, too low; but as Favre gives its force in oxygen as 6565, and Andrews 7510, it is clear there is room for further information.

The first two lines of the last table are connected with several important facts. A Smee cell tested for electromotive force by condensers, or in any way which prevents the production of current, gives the measure of the force developed without the setting free of hydrogen as a gas, and this force is considerably higher than that of the same cell in full work; the difference is the measure of the *energy rendered latent* by hydrogen becoming gaseous, and it is about 0·583 equivolts. An example or two will show the value of this exact mode of estimating what happens in our batteries:—

	Equivolts.
Energy of zinc, Table C.	2·248
[*] Counter force of silver, Table C. ...	0·260
Force of combination	1·988
Energy of hydrogen, Table D.	0·881
Electromotive force not working ...	1·107
Latent energy of gas	0·583
Electromotive force when working ...	0·524
Difference of copper and silver, Table C.	0·246
Electromotive force of copper and zinc	0·278

As explained before, all these figures are but approximate. So also in the measured electromotive forces of different cells given by various authors there are very great differences, showing that much remains to be learnt.

It may be remarked here incidentally that the foregoing considerations effectually settle the old question, lately revived, of the contact and chemical theories. Two different metals in contact undoubtedly generate a certain molecular condition analogous to polarisation, as must all dissimilar substances, but this is not the source of any force, or it would be alike with different liquids, whereas it is strictly in accord with the chemical affinities in operation alone. In all probability the results found experimentally when metals are put in contact are due *not to that contact*, but to the polarisation produced in the surrounding moist air, which generates a static effect analogous to that existing in a galvanic cell before the circuit is closed.

It is a common practice to charge the zinc compartments of batteries with a solution of common salt instead of sulphuric acid, the object being to reduce waste and loss by local action; this is also attended with a higher electromotive force. The reason will be seen by a reference to the tables in the higher energy due to the union of chlorine with zinc giving a higher balance of energy. But notwithstanding this, the current produced is lower in most cases.

An important element in the value of batteries is the relative "internal resistances," because this is pure loss of energy. This resistance depends upon several conditions:—1. The area of the plates to which it is in one stage proportional; 2. The specific conductivity or resistance of the liquids used, which is also affected by their strength or degree of concentration; 3. The distance apart of the plates, upon which depends the actual liquid resistance; 4. The porosity of porous vessels when used.

Our knowledge of liquid resistances is very imperfect. The following values for solutions commonly used in batteries is taken from Becquerel:—

E. Liquid Resistances.

	Temperature.	
Copper taken as standard... ...	32°	1
Sulphate of copper, saturated ...	48	16,855,520
„ „ diluted to half	„	26,327,637
„ of zinc, saturated ...	56	15,861,267
„ „ diluted to half	„	12,835,836
Chloride of sodium, saturated...	„	2,903,538
„ „ diluted to half	„	3,965,421
Sulphuric acid, diluted 1 to 11...	68	1,032,020
Nitric acid, strength not given...	—	976,000
Distilled water	59	6,754,208,000

We see here the reason of the apparent paradox of chloride of sodium with higher electromotive force giving commonly less currents; its resistance is three times that of acid, and when the external resistance is but small, the extra force is all absorbed by the increased resistance.

MATHEMATICS
FOR
NATURAL SCIENCE STUDENTS.

By T. C. SIMMONS, B.A. Magdalene College, Cambridge.

(Continued from p. 135.)

Trigonometry (*Continued*).

Let us take a piece of cardboard, and with a pair of compasses draw a circle with a diameter of 7 inches. If we cut it out, and measure the length of the circumference with a piece of string, we shall find it to be about 22 inches. Thus, the circumference of this particular circle is about $3\frac{1}{7}$ times the diameter. If we now draw another circle, with any radius whatever, and measure its circumference in a similar way, we shall find it to be about $3\frac{1}{7}$ times the diameter. Thus the circumference bears a fixed ratio to the diameter. The real value of this ratio, expressed to 4 places of decimals, is $3{\cdot}1416$, and is denoted by the Greek letter π (pronounced *pi*). We thus know two properties of circles:—

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[*] The electromotive force of the Smee cell is that due to silver; platinising the silver does not increase it, but only resists the adhesion of hydrogen.

(1). In a circle, the magnitude of the angle contained between any two straight lines drawn through the centre is proportional to the length of that part of the circumference which is included between the two lines.

(2). The ratio of the circumference to the diameter is constant for every circle, and is denoted by π.

There are certain other geometrical properties with which it is necessary to be acquainted before we can proceed to the direct study of trigonometry. I shall begin with the simplest. If any straight line, such as A B, meets another, as C D, it makes with C D two angles, viz., A B D, A B C. One of these is in general greater than the other, but if A B move until it is at right angles to C D, or, in other words, perpendicular to C D, then the two angles become equal, and each of them is a right angle.

Fig. 8.

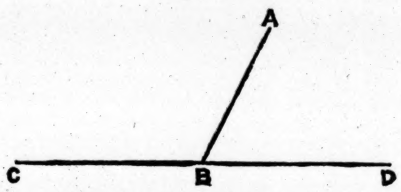
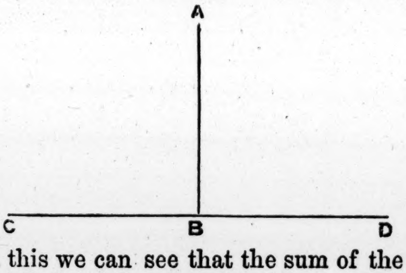


Fig. 9.



From this we can see that the sum of the angles A B D, A B C in the first figure is equal to two right angles. For let B E be drawn perpendicular to C D, then the angles A B D, A B C are equal to A B D, A B E, E B C, and E B D, E B C are also equal to A B D, E B A, E B C; so that A B D, A B C are equal to E B D, E B C, or to two right angles. But if the two straight lines pass through each other and meet as at F, we get two other angles on the lower side of C D. Of these, C F B is equal to A F D, and B F D equal to A F C. We can soon prove it by cutting a piece of paper so as to fit the angle A F D. It will be found to fit C F B also.

Fig. 10.

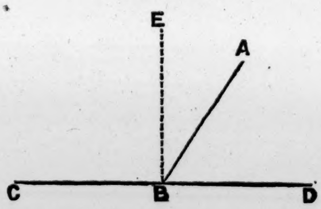
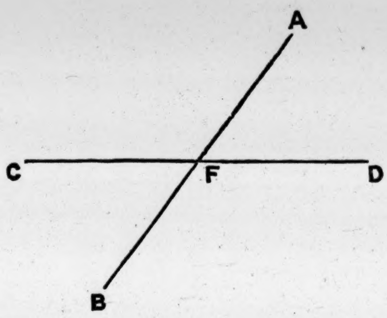
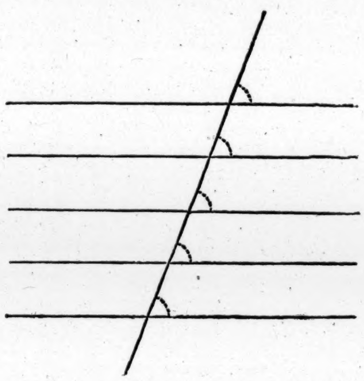


Fig. 11.



If we draw a number of parallel straight lines meeting A B, we get several equal angles. Parallel lines, as I suppose the student knows, are those which are always at the same distance from each other, as the two rails on which a locomotive engine travels. If a number of such lines be drawn, as in the figure, it will be found, if we cut a piece of paper so as to fit any one of the angles shown by the dots, that it will fit all the others, thus showing that all these angles are equal.

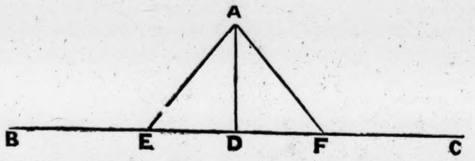
Fig. 12.



Now let us take a point A and a straight line B C, and draw A D perpendicular to B C (Fig. 13). Then, if we join A to any point of B C, the farther this point is from D the greater is the length of the joining line and the smaller is the angle which it makes with B C. This may be seen by taking a point E and joining A E. If a number of lines be drawn from A, then any line meeting B C at a point between D and E will be less than A E, and the angle which it makes with B C will be greater than A E D. The contrary will hold if the line meets B C at a point further from D than E. The lines will then continually diminish as the point approaches D, when the line will have reached its least value. It will then begin to increase, and will continue to do so afterwards. The dotted lines in the figure are supposed to represent some of the lines.

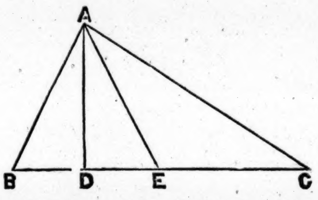
If, now, A D be perpendicular to B C, and D E D F be taken equal to one another on opposite sides of A D and A E, A F be joined, A E will equal A F, and the angle A E D will equal A F D. For if the part to the right of A D be bent round over the other, so that the crease of the paper is along A D, F must fall on E, and A F must fall on A E, and the angle A F D on A E D. Thus when two angles of a triangle are equal, the opposite sides are equal, or when two sides are equal the opposite

FIG. 14.



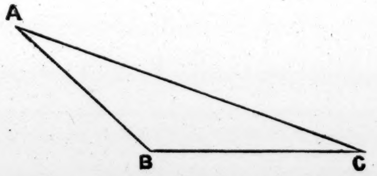
angles are equal. But suppose we have a triangle A B C in which a side A C is greater than A B. Draw A D perpendicular to B C, and a line to the right of A D equal to A B. Since A B is less than A C, this line will meet B C at some point between D and C at E. Then the angle A E D is greater than A C D, because E is nearer D than C is, and therefore the angle A B D, to which it is equal, is greater than A C B. Thus if one side of a triangle be greater than another, the angle opposite to the one side is greater than the angle opposite to the other.

FIG. 15.



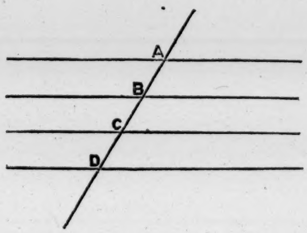
Of course in a triangle A B C, where A B and A C both fall on the same side of the perpendicular from A or B C, it is still more easily seen that A C is greater than A B and the angle A C B less than A B C, for A C B is less than a right angle and A B C greater than a right angle.

FIG. 16.



I shall now, in proving another property, assume that if a number of parallel lines be drawn at equal distances from each other, and a straight line, as A B C D, meets them all, then the parts A B, B C, C D, &c., are all equal. This the student will, I think, admit, so that I need not discuss it.

FIG. 17.



Let now A be a point at some distance from a straight line B C, and let A B, A D, A C be drawn meeting B C. Suppose a great number of lines drawn between A and B C, all parallel to B C.

FIG. 13.

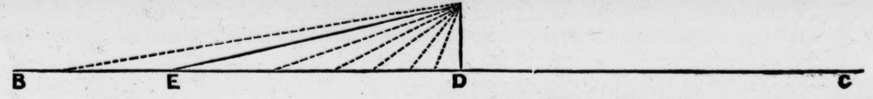
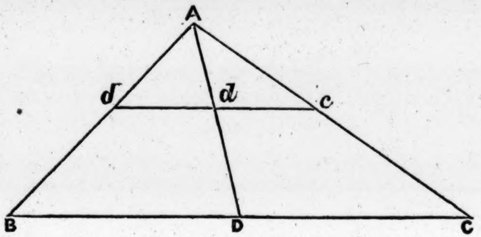


FIG. 18.



Suppose, for the sake of exactness, there are 100 drawn, and that they all are at the same distance from each other. Let *b d c* be any one of these lines, say the 41st, reckoning from A. Then, since A B is divided into 100 equal parts by the lines, and 41 of these parts are in A *b*, and the remaining 59 in B *b*, it follows that the ratio of A *b* to B *b* is $\frac{41}{59}$. So the ratio of A *d* to D *d*, and A *c* to C *c* is the same. Thus the ratios A *b* : *b* B, A *d* : *d* D, A *c* : *c* C are all equal. We have then the following theorem:—If a line D E be drawn parallel to B C, one of the sides of the triangle A B C, then A D : D B : : A E : E C. Of course we get in the same way that A B : A D : : A C : A E. Or the same thing might have been shown in the manner employed in the following proposition. We know that in photography, or any other process in which objects are faithfully represented, on a scale differing in size from the originals, that all the parts preserve their proper proportions. For instance, if a window of a house be three times as long as it is broad, the

FIG. 19.

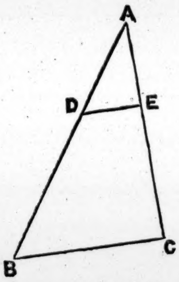
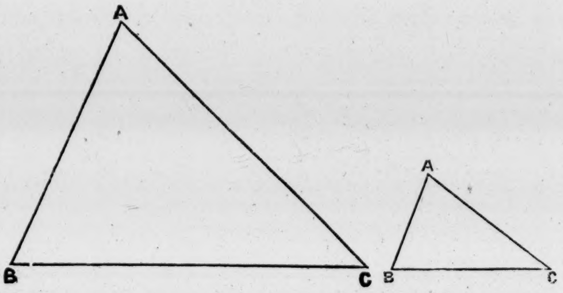


FIG. 20.



same proportion will hold in the photograph of the house; the length will be three times the breadth. Now suppose we have two triangles, equiangular, but of different sizes, as in Fig. 20.

Then, if we take a photograph of A B C, so that B C becomes of the same size as b c, A B will become of the same size as a b, and A C of the same size as a c. But in a photograph all the parts are diminished in the same proportion; thus A B : a b is the same as A C : a c, or as B C : b c. Or in equiangular triangles the ratio of any side of the one to the corresponding side of the other is the same for all the sides. Or to put it in another light: a b c being the photograph of A B C, the sides of one triangle will bear the same proportion to one another as the sides of the other, corresponding sides being taken thus, A B : A C :: a b : a c, A B : B C :: a b : b c, and B C : A C :: b c : a c. If the employment of this illustration be objected to, the same thing may be seen by holding A B C and a b c at different distances from the eye, A B C being farther off than a b c. If the distances be properly adjusted, A B C will be seen to be apparently equal to a b c in every respect, and the same conclusions will follow.

Let us now take a triangle A B C, and find E, F the middle points of A C, A B, or as they are usually called, the points of bisection of A C, A B. Join E F, and bend the triangle A F E over the rest of the figure. We shall then get a figure like the following, where *a* is supposed to correspond with A. Then A F being equal to B F, so is *a* F. Thus *a* F and B F being equal, the angle B is equal to F *a* B. In the same way the angle C is equal E *a* C, and the angle A is the same as the angle F *a* E Thus the three angles C, A, B are equal to the three E *a* C, E *a* F, F *a* B, or to two right angles. If, however, one of the angles, as A B C, be greater than a right angle, it will be better to bend round the triangle B F D, where D, F are the middle points of B C, A B, and the same thing will follow. Thus the three angles of any triangle are together equal to two right angles.

Fig. 21.

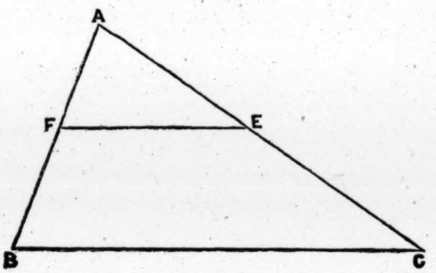


Fig. 22.

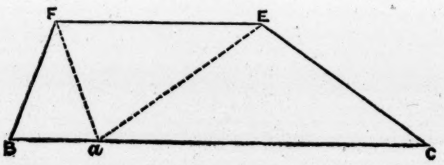
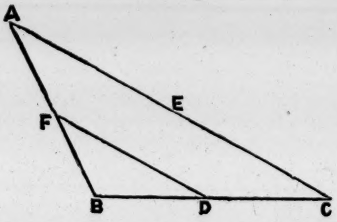


Fig. 23.



To form a square equal to the sum of two given squares.

Let A B C D, E F G H be two squares. Mark off along C B a part C K equal to F G, and draw K L perpendicular to D K. Make G M equal to B L, and join E M. Put numerals 1, 2, 3, 4 along the sides, as in the figure, each numeral being put twice. Then cut along the lines, getting five pieces (I suppose the squares to be drawn on cardboard or paper). Now put 1 against 1, 2 against 2, and so on; thus we get a new figure which will be found to be a perfect square, thus :—

Fig 24.

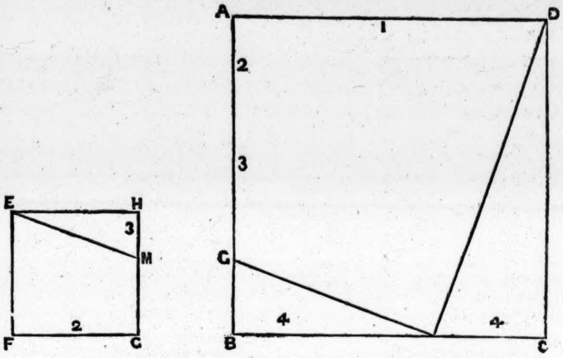
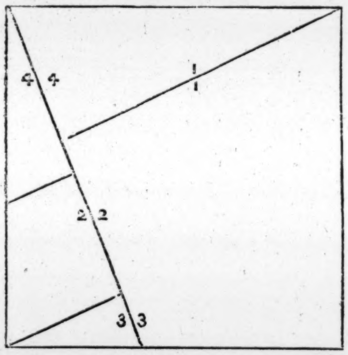


Fig. 25.



What is this square? Evidently that described on K D. Also the given squares are equal to those described on C D, C K. Thus the square on the hypothenuse (or the side opposite the right angle) D K is the sum of the squares on the sides C K, C D. This holds for any triangle.

We now know the following propositions, in addition to (1) and (2).

3. If a straight line A B meets another C D, making on the same side of C D the angles A B D, A B C, these are together equal to two right angles (Fig. 8).

4. If two straight lines meet one another at F as A B, C D, the angle A F D = C F B and A F C = B F D (Fig. 11).

5. If a straight line meets a number of parallel straight lines, as in Fig. 12, all the corresponding angles are equal.

6. If two sides of a triangle are equal, so are the opposite angles; and if two angles are equal, so are the opposite sides.

7. In a triangle the greater side is opposite the greater angle.

8. A line drawn parallel to one of the sides of a triangle cuts the other sides in the same ratio (Fig. 19).

9. Equiangular triangles, or triangles which have the angles of the one equal to the angles of the other, have their corresponding sides all in the same ratio to one another.

10. The same triangles are such, that the ratio of any two sides of one of them is equal to the ratio of the corresponding sides of the other (Fig. 20).

11. The three angles of any triangle are together equal to two right angles.

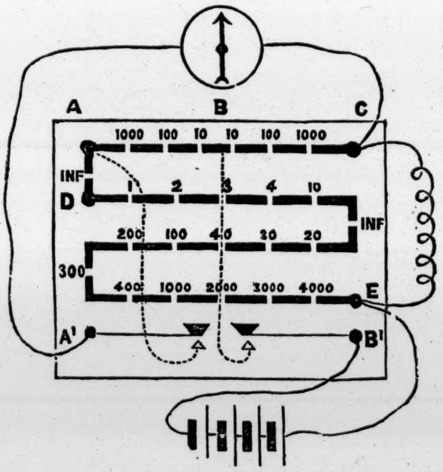
12. In a right-angled triangle, the square on the hypothenuse is equal to the sum of the squares on the other two sides.

Students' Column.

Resistances and their Measurement.—By H. R. Kempe.

IX.—When the conductivity resistance of a line of telegraph is measured by having the further end of the line put to earth, the errors arising from the presence of earth currents may be eliminated by making two measurements, one with a zinc and another with a copper current, and taking the mean of the two results. This mean value, although not strictly the correct resistance of the line, is not far wrong when the two results do not differ very largely from one another. To get the exact value from the two measurements is a tedious process requiring a knowledge of the resistance and electromotive force of the testing battery, and also the electromotive force of the earth current, which must, of course, be constant at the time the measurements are being made. By earth currents we mean the currents set up by electrical disturbances over the surface of the earth, and also currents due to the polarisation of the earth plates.

Fig. 11.



When the battery connections for measuring conductivity are made, as in Fig. 11, in order to put the zinc current to line, we should put the cable to C and the earth to E. To put the copper to line we can either reverse the battery or put the cable to E and the earth to C, whichever is most convenient to the experimenter.

When we are measuring the conductivity of a submarine cable, which requires to be carefully done, the best method is as follows:—First put on the battery current for half a minute by pressing down the right hand key; at the expiration of that time, proceed to adjust the plugs, pressing down the left hand key as required until equilibrium is produced; continue to adjust, if the needle does not remain at zero, and at the expiry of half a minute note the resistance. Now reverse the battery connections, put on the current for half a minute; again measure, again reverse and measure, and so on until about a dozen measurements with either current have been taken. It will usually be found that about half the measurements made with the negative current are the same, and also half the measurements made with the positive current; these results may be taken as the correct measurements, and the mean of the two gives the required resistance. If the earth at either the testing or the further station be defective, *i.e.*, if they have a resistance, the error cannot be eliminated by testing with the two currents. It is therefore necessary to know, before making a conductivity test, whether both earths are good, otherwise the measurements are useless.

The presence of earth-currents can be detected when the line, galvanometer, and earth are joined to the resistance-box, by pressing down the left-hand key alone. This will cause the galvanometer needle to be deflected if there are any currents present. A line is seldom if ever quite neutral.

It is almost immaterial what battery power is used in measuring conductivity; sufficient, however, should be used to obtain a good deflection on the galvanometer needle when equilibrium is not exactly produced. It is not advisable to use a very low power, for if the earth currents be at all strong the positive and negative measurements may differ largely. About 30 or 40 cells is a convenient number to employ. There is no danger of heating the resistance coils with such a power if the battery be a Daniell charged with plain water, or even a Leclanché, as their internal resistance is considerable. It would not be advisable, however, to use a Grove or a Bunsen battery, or a Daniell charged with acidulated water, as their heating power is great in consequence of their small internal resistance.

Testing for Faults.—The theoretical methods of testing for the localities of faults are comparatively simple, but their practical application presents some difficulties. The simplest kind of fault to localise is a complete fracture in a cable where the fault offers no resistance, and the conductivity resistance gives at once the position of the fault. Thus, a line which was 100 miles long, and in its complete condition had a resistance of 1350 ohms, that is to say, a resistance of $\frac{1350}{100} = 13{\cdot}5$ ohms per mile, gave a resistance of 270 ohms when broken. Then distance of fault from testing station is—

$$\frac{270}{13{\cdot}5} = 20 \text{ miles.}$$

When the fault has a resistance, the localisation becomes more difficult. The following is the method generally adopted:—Let A B be the line which has a fault at C, A being the testing-station. A gets B first to insulate his end of the line. He then measures the resistance, which we will call l. Then—

$$a + f = l$$

therefore—

$$f=l-a. \quad (1).$$

Next, B puts his end to earth, and A again measures. Let the new resistance be l_1, then—

$$a+\frac{fb}{f+b}=l_1 \quad (2).$$

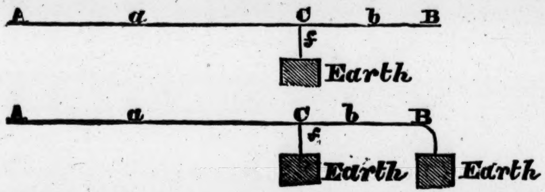
Calling L the resistance of the line, we have also—

$$a+b=L$$

therefore—

$$b=L-a. \quad (3).$$

FIG. 12.



From these three equations we have to determine a. Substituting the values of f and b from (1) and (3) in (2), we get—

$$a+\frac{(l-a)\,(L-a)}{L+l-2a}=l_1$$

therefore—

$$a^2-2al_1=Ll-Ll_1-ll_1$$

from which—

$$a=l-\sqrt{(l-l_1)(L-l_1)}$$

For example—

A faulty cable, whose total conductivity resistance when perfect was 450 ohms (L), gave a resistance of 400 ohms (l) when the further end was insulated, and 60 ohms (l_1) when the end was put to earth, what was the resistance of the conductor up to the fault?

$$\text{Resistance}=400-\sqrt{(400-60)(450-60)}=150 \text{ ohms}$$

If the length of the cable was 50 miles, then conductivity per mile equals $\frac{450}{50}=9$ ohms, and distance of fault from testing station consequently equals $\frac{150}{9}=15\frac{5}{9}$ miles.

In the second method of testing, two measurements are made, one by station A, and the other by station B, A and B insulating their end in turn. Thus resistance measured from A when B insulates as before is—

$$a+f=l.$$

Resistance measured from B when A insulates—

$$b+f=l_2$$

also—

$$a+b=L$$

subtracting first from second—

$$a-b=l-l_2$$

and adding to third—

$$2a=L+l-l_2$$

therefore—

$$a=\frac{L+l-l_2}{2}$$

For example—

A faulty cable, whose total conductivity resistance when perfect was 450 ohms (L), when measured from A with the end at B insulated, gave a resistance of 400 ohms (l); and when measured from B with the end A insulated, a resistance of 250 ohms, what was the resistance of the conductor from A to the fault?

$$\text{Resistance}=\frac{450+250-400}{2}=150$$

So far the testing is simple; the practical application, however, presents some difficulty; this is owing to the variation of the resistance of the fault when the testing current is put to the cable in consequence of this current acting on the copper conductor, and through the agency of the sea water covering it with a salt which, besides increasing the resistance of the fault, also sets up a current opposing the testing current. To make a proper test, then, it is necessary so to manipulate the testing apparatus and battery as to get rid of the polarisation and resistance set up by the salt formed on the fault, and to measure the resistance at the moment this is done. The following is Lumsden's method:—The conductor is first cleaned at the fault by applying a zinc current from 100 cells for 10 or 12 hours, the current being occasionally reversed for a few minutes; a rough resistance test is then made with a copper current. This being done, the resistance box is removed without disturbing the plugs. A positive current from some large cells is now applied for about two minutes, using two or three cells for every 100 units of resistance which have been measured. This coats the conductor with chloride of copper. The cable is now again connected to the resistance box, the battery being joined up as shown in Fig. 11, that is to say, the zinc pole to terminal B′ and the copper to terminal E, the cable to C, and earth to E. Both keys being now depressed, the galvanometer needle is carefully watched, and plugs are inserted and shifted unit by unit, so as to keep the needle at zero; for the action of the negative current is to clean off the chloride of copper, and thereby to reduce the resistance of the fault. At a certain point this decomposition becomes complete, and the needle of the galvanometer flies over with a jerk, showing that a disengagement of hydrogen has taken place at the fault which enormously increases its resistance. The resistance in the resistance box at that moment is the required resistance.

The fault being once cleaned by the application of the 100 cells for 10 or 12 hours, it is unnecessary on repeating the measurement, which should always be done, to apply the battery for so long a time, 10 or 20 minutes or even less will generally suffice. When the measurement is made with the further end of the cable to earth, the same process of preparation can be employed. It is best, however, to make the test with the end insulated first. Before making the tests, A must of course arrange with B, or *vice versâ*, at what time and for how long he is to insulate, put to earth, &c., his end of the cable.

Practice is required before these tests can be satisfactorily made. An artificial line, however, can easily be made with resistance coils to represent the resistance of the line up to the fault, and a short piece of cable core which has been pierced with a needle for the fault itself. This piece of core is immersed in a vessel of sea water, using a piece of galvanised iron plate or wire for an earth. By this means a very fair idea of the difficulties encountered in testing for faults in cables may be obtained, and good practice made.

(To be continued).

ON the 1st inst., telegraphic operations at Woolwich Arsenal and Dockyard, as well as at other Government establishments, were taken under the charge of the General Post Office authorities.

Proceedings of Societies.

SOCIETY OF TELEGRAPH ENGINEERS.

At the meeting held on the 25th March, Mr. Latimer Clark, Vice-President, took the chair.

A paper on "*The Decay and Preservation of Timber for Telegraph Purposes*" was read by Mr. W. Langdon. The abstract will appear in our next number.

The Chairman, in inviting a discussion, said that the subject was one of very great importance, both in this country and in other lands.

Mr. Golston said that Mr. Langdon and he had been talking over the matter, and they very much agreed upon things generally. The first timber which he had seen treated by having its ends dipped in creosote, as represented in one of the diagrams, was some hop-poles in the county of Kent. The process was a "wrinkle" to him. On his going over some hop-grounds in that county a few years ago, the proprietor showed him a lot of poles that had been served in that way. They had been simply placed in a tank of boiling creosote; and the owner stated that he saved a considerable sum per annum by that simple method. About twelve months afterwards Mr. Langdon suggested to him that telegraph poles should be served in that fashion, and he (Mr. Golston) at once said that he had heard of the hop-poles being so treated with great advantage. Mr. Langdon started the application of the process to telegraph poles, and the poles upon the postal line to Beachey Head had been served in that way. He hoped that some great advantage would be gained, but the time had not been sufficient as yet to prove whether the process really did what was required. If he had an opportunity at the next meeting, he would exhibit a piece of one of the poles to which Mr. Langdon had referred as having been in the ground for five and twenty years. Those were creosoted poles. The Boucherised timber had been referred to as being used on the South Western line. He rather liked the Boucherising method. He could not say that it really answered its purpose as well as creosoting; but a Boucherised pole could be painted and made to look better than a creosoted one, and there were, of course, occasions upon which they could not use a black pole, for other peoples eyes had to be pleased. Hence it was very useful to have a piece of timber which was prepared, and which was nevertheless as easily adapted in such cases as a piece of plain timber. The poles on the Yeovil and Exeter line which were spoken of as having been taken out in 1871, were planted by the late Telegraph Company as an experimental line. The line had been renewed throughout. When the line was planted, they put in, alternately, plain poles, creosoted poles, and Boucherised poles, in order to give the methods a fair trial. The plain poles consisted of larch, Scotch fir, and spruce. The Boucherised poles were of Scotch fir. The creosoted poles were generally Norway red fir. Not one of the creosoted poles was found to be decayed, and in all cases they could be used again. Not one of the plain poles could be used again; they were all rotten. In some parts they were in a very bad state indeed, especially near the ground line; but they were more or less rotten all the way up. He thought they found that about 30 per cent of the Boucherised poles were gone near the ground. It occurred to him at the time that the reason of that was that they had not been properly Boucherised in all cases. The sound ones were used to replace other lines. They were now in use, and time would show the real value of them.

Mr. Bell said that, from his experience of tarred poles, he believed that tarring would be detrimental rather than otherwise to the poles unless they were dried, and for the reason which Mr. Langdon had given in his paper in reference to creosoted poles, which was that unless they were dry the moisture would be driven inwards. He happened to know a case on the Midland Railway in which charred and tarred poles had been used. They were felled and dressed green, and finished before there was time to season them. It fell to his duty some four years afterwards to go over the line, and spur the poles at the bottom, and renew them if necessary. A very large proportion of the poles was completely decayed; and it was very singular that just at the place where the charring commenced the decay took place. The sap of the pole had descended to that spot. Of course it stopped there, as it could not get below it. The decay was accelerated by the moisture being, as it were, sealed up in the pole. He was so much struck with this fact, that he made a proposal that the poles put up afterwards should be left open for a time, in order that the wood might season before they were tarred. He did not know the result of that step, but he believed that, unless poles were treated in that way before the application of the creosote, the treatment with the creosote would be mischievous rather than otherwise. Another thing to be considered was that they could not hope by mere tanking in creosote to reach to a very great depth into the wood. The ordinary creosoting was done under very great pressure. From 120 to 150 lbs. on the square inch was put on the cylinders to force the creosote into the sap. In a large number of pieces of red wood and pine which he had examined the creosote had scarcely penetrated at all. Red wood scarcely required creosoting, for the turps in it kept it longer than the creosote. Mr. Langdon had omitted to speak of a very important process called Beer's process. The wood was steeped in a solution of borax, and that salt was supposed to neutralise the decomposition of the vegetable matters in the wood, and these were afterwards washed out.

The Chairman said that he should like to ask the speaker and everyone else present who could give the information, whether they had ever seen a case in which wood which had been creosoted to any depth, however slight, had decayed thoroughly in the inside when the creosote had failed to penetrate. Had it or had it not acted as a preservative?

Mr. Bell said that he could speak only with regard to railway sleepers. Those that he had known to have been creosoted and removed were removed, not on account of decay, but on account of having been battered to pieces by the chairs. He wished to ask Mr. Langdon whether those poles which he had found decayed on the Portsmouth line were of red wood.

Mr. Langdon said they were of foreign timber. His impression was that they were memel.

Mr. Richerwood, in reply to the Chairman, said that his experience of the timber was very limited. The poles which he had fixed in the neighbourhood of London had been fixed only four years, and therefore they had had very little opportunity of decaying, and none of them had, as yet, shown any sign of doing so. Some of them had been treated with a preservative preparation, and some had been fixed without such treatment.

Mr. Von Truenfeld said that he had not been concerned with wooden posts in England, but he knew of tropical trees which would last, he should say, at least 200 years without showing the slightest signs of decay. He had had occasion to take up poles which had been used in building, and which had been in the ground for over 100 years without showing the least sign of decay or corrosion on the ground line. They were poles made of trees growing in the interior of South America, and which were called in the native language the urunday and the curupay trees. They were generally called by English people "iron-wood." The wood was so hard that it was impossible to drive a nail into it. It would, perhaps, be an advantage if it could be brought to this country, and used for telegraph poles. He should think that it would last for hundreds of years.

The discussion will be resumed on the 22nd inst., at 7.30 p.m. Should time permit, the following communications will also be read:—"*On the Change of Resistance of High Tension Fuzes at the Moment of Firing*," by Major MALCOLM, R.E.; "*Notes on Electric Fuzes*," by Prof. ABEL, F.R.S. Sir William Thomson will, in the course of the evening, explain his method of deep-sea sounding by means of piano-forte wire.

Notices of Books.

A Handbook of Practical Telegraphy. By R. S. CULLEY, Member Inst. C.E., Engineer-in-Chief of Telegraphs to the Post-Office. Adopted by the Post-Office and by the Department of Telegraphs in India. Sixth edition, revised and enlarged. London: Longmans, Green, Reader, and Dyer. 1874.

SEVERAL years have elapsed since Mr. Culley first brought out this book, and each succeeding edition has invariably been enlarged with the record of improvements in the science of telegraphy and with descriptions of new inventions in signalling instruments. The sixth edition, now before us, shows plainly by its bulk that a great deal of additional matter has been added to its pages, whilst its perusal proves that the author spares neither pains nor trouble to maintain the volume as one of the standard works of the science; consequently the present edition is far in advance of those preceding it. This result is what might have been expected of Mr. Culley, since he is placed in a peculiarly favourable position for acquiring information on all points relating to telegraphy; more especially those of overland and underground lines, the consideration of which forms some of the most important chapters of his book. The following are the contents:—Part I., Sources of Electricity. Part II., Resistances and the Laws of the Current; the Earth. Part III., Magnetism and Electro-Magnetism. Part IV., Induction; Static Induction; Dynamic Induction. Part V., Atmospheric Electricity; Earth Currents. Part VI., Insulation. Part VII., The Construction of a Line of Telegraph. Part VIII., Ordinary Testing. Part IX., Telegraphic Signalling Instruments. Part X., Underground and Submarine Telegraphs; Underground and Tunnel Work; Submarine Cables; Tests During Laying Cables, &c. Part XI., Eighteen Useful Tables of Logarithms, Sines, Tangents, Resistances, and Various Coefficients.

As usual, "The Source of Electricity" is first referred to as the result of friction; but afterwards the author launches out into full descriptions of the "Daniell Battery," "Minotto Battery," "Graphite Battery," "Sand Battery," "Modified Smee's Battery," "Leclanché's Battery," "Marie-Davy Battery," and "Secondary Batteries," with explanations of the internal chemical actions set up between the plates and the solutions whenever their circuits are closed. To the subject of these actions a great deal of attention has been directed. They are complex, and certain evils follow in their wake which produce a reflex of the electric energy, thereby seriously weakening the effective power, if they do not entirely destroy it. This local action is the chief enemy in batteries, for necessarily it destroys the great "desideratum,"—a constant current: therefore the telegraphist is specially enjoined to observe certain instructions essential to the maintenance of a constant current without unnecessary waste of metal. In the second part, instructions are given how to join up a battery so as to get work out of it best suited to lines of various resistances. This chapter contains numerous calculations and many illustrations to guide the student, who cannot fail to well learn his lesson where so much minutiæ of detail are given.

To the duplex system a lengthy chapter is devoted, and the apparently paradoxical statement of telegraphing two ways at one and the same time is well treated of. The explanation is very lucid, and the reader is gradually led on from one statement to another until he perceives the practicability of the system. We notice that only two of the methods are dwelt upon, viz., "the Bridge" and "the Differential." There is another,—"the Leakage,"—which acts somewhat in the same way as the other two, but is not so generally known, nor, we believe, so practicable, and no doubt it has been purposely excluded from these pages for that reason. A very general supposition is that by the duplex system currents from A and B pass each other along the line, so that A's current shall operate on B's needle, whilst B's current operates on A's needle. Strictly speaking, such is not the case,—we have never seen it directly stated otherwise,—although the result is the same. In reality A's own current, whilst it telegraphs its own message to B, records at the same time B's message on A's instrument. The process is accomplished merely by the power which B possesses of retarding and assisting A's current, and *vice versa.* A great improvement in the present edition is the rejection of that old-fashioned word, "tension," and the substitution of the word "potential," which is much more expressive. At the same time we do not think Mr. Culley's definition of this word sufficient for some who use his Handbook as a work of reference. The book is rendered a safe PRACTICAL work of reference because "questions simply hypothetical" are not discussed, and because "those parts of electrical science which have not an immediate bearing on telegraphy" are not entered into. We heartily recommend it to operators, and other practical men, on account of its containing a store of technical knowledge "hitherto attainable only by means of verbal instruction or actual experience."

The A B C Universal Commercial Electric Telegraphic Code, specially adapted for the use of Merchants, Shipowners, Brokers, Agents, &c. By W. CLAUSON-THUE. London and New York: E. & F. N. Spon. 1874.

No merchant who transacts a large foreign business, and repeatedly telegraphs messages requiring secrecy, ever thinks of sending them in full. He employs the well-known code system for the double purpose of maintaining secrecy of transmission, and reducing the cost. Hitherto it has generally been the practice to mainly use cipher messages composed of figures, and hence the frequency with which the receiver is puzzled to interpret the meaning of the message from very slight mistakes, such as making 1 for 0, or some other figure for another. Operators know to their cost the difficulty of receiving or sending a message composed of figures only, for whatever the system may be of repeating the messages, grave errors are sure to unsuspectingly creep in. "These and other equally great disadvantages satisfied the compiler that an attempt should be made to overcome them," and "he ventures to submit the A B C Universal Code to public notice." He secures simplicity by a single code word for each sentence to be telegraphed, and the code word being an ordinary "dictionary" one is not so liable to be dispatched or received wrongly as a series of meaningless numerals. Secrecy, of course, under any system renders the message liable to misinterpretation, but Mr. Clauson-Thue, by discarding numerals and substituting letters, bases his system on the safest foundation possible. In this respect he cannot claim any special benefit, because "Books of Code Signals" in letters have been for a long time much in use. The merit he claims is that *perfect* secrecy is secured, though how far he is right experience alone can prove. From our own inspection of the work, we can bear testimony to its extreme simplicity, which, in these days of bustle and commotion, is in itself a good recommendation.

A Manual of the Mechanics of Engineering, and of the Construction of Machines, with an Introduction to the Calculus. Designed as a Text-book for Technical Schools and Colleges, and for the use of Engineers, Architects, &c. By JULIUS WIESBACH, Ph.D., Oberbergrath and Professor at the Royal Mining College at Freiberg; Member of the Imperial Academy of Sciences at St. Petersburg, &c. Vol. I. Theoretical Mechanics. Translated from the Fourth augmented and improved German edition. By ECKLEY COXE, A.M., Mining Engineer.

OUR British publishers must be vigilant, and carefully study the demands of modern science, or their American rivals will ere long outstrip them in the race, and provide the English reading races with their best scientific text-books. Brother Jonathan is evidently awakening to the truth that the cultivation of science and its practical applications may be more profitable than the manufacture of wooden nutmegs, and is following up the new "notion" with characteristic energy.

The work before us, published in New York by D. Van Nostrand, is one among many other indications of the scientific awakening of our transatlantic brethren. It is a well printed and well illustrated volume of 1112 pages, and the first of the three in which the work will be completed. At the end of the book is a formidable list of technological works published by the same firm. This list is alone sufficient to justify the above reflections.

The volume before us is a thorough and satisfactory exposition of the fundamental principles of mechanical science, treated with especial reference to their practical bearings. The author's principal effort has been to obtain the greatest simplicity in enunciation and demonstration, and to treat all the important laws, in their practical applications, without the aid of the higher mathematics. At the same time he does not agree with those authors who, in popular treatises, enunciate without proof the more difficult laws, but he prefers to deduce or demonstrate them in an elementary, although sometimes in a somewhat roundabout, manner. It is assumed that the reader has a general knowledge of the fundamental principles of natural philosophy, and of elementary pure mathematics, but the use of the Calculus is avoided, the author stating one of his reasons for this, viz., that "it is an undeniable fact that, unless we are constantly making use of it, we soon lose that facility of calculation which is indispensable."

Somewhat inconsistently with this statement, the first part of the work is an "Introduction to the Calculus," where the subject is treated with considerable simplicity and clearness. This is followed by a treatise on "Phoronomics, or the Purely Mathematical Theory of Motion," divided into two chapters; (1.) on Simple Motion; (2.) Compound Motion. This, with the Introduction to the Calculus, forming the mathematical portion of the volume, occupies the first 153 pages. In the second section, two chapters are devoted to a general outline of Mechanics, defined as "The Physical Science of Motion." This subject is treated more in detail in section 3, wherein are included the General Principles of the Statics of Rigid Bodies; he Theory of the Centre of Gravity; the Equilibrium of Bodies rigidly fastened and supported; the Equilibrium of Funicular Machines; the Resistance of Friction, and the Rigidity of Cordage.

Section 4 is devoted to the Application of Statics to the Elasticity and Strength of Bodies, and treats in detail the Elasticity and Strength of Extension, Compression, Shearing, Flexure, and Twisting, and the Resistance to Crushing by bending or breaking across.

The Dynamics of Rigid Bodies is the subject of the four chapters of Section 5; the Statics and Dynamics of Fluids are treated in sections 6 and 7, which are followed by an Appendix on the Theory of Oscillation.

This slight sketch of the contents of the volume sufficiently indicates its scope and objects. The subjects are conscientiously and well treated, with a sufficient amount of mathematical demonstration for all practical purposes, with rather more, we fear, than will be acceptable to the majority of English practical men, by whom these subjects should be well understood, But we must remember that it is a German work written originally for German engineers and mechanics, who have at the elementary and *real-schule* received an amount of mathematical preparation that in this country is unfortunately but rarely attained before entering the Universities. Still we have some men in our own country whose education is superior to even the best that any school or college can afford; the men who, in spite of all difficulties, have educated themselves. To such men who have thus mastered the elements of mathematics, and are preparing to take the high technical position to which they are entitled, this work is especially valuable. It supplies them with a mine of worthy study, treated just in the manner and to the extent that such self-taught and self-teaching men demand. We hope it may fall into such good hands, and be well thumbed and studied by many of them.

Electrical Science in English and Foreign Journals.

Comptes Rendus Hebdomadaires des Séances de l'Academie des Sciences, Vol. lxxviii., No. 11.

Experimental Researches Leading to a Determination of the Sun's Temperature.—By P. A. Secchi.—Describes some experiments to determine the relation of solar radiation to that of the electric light, so as to clear up, if possible, the question of solar temperature. The electric light was chosen from being, of all luminous sources, nearest to that of the sun in intensity, and also to diminish the differences of opinions attending the law of radiation according as the theories of Newton, Dulong, and Petit, are adopted. The *Thermhéliometre*, described in his work *Le Soleil*, was employed. The author measured the heat of the *surfaces* of the carbon poles of a Bunsen's battery of 50 elements, with a solution of 40 parts of nitric acid to 100 of water, and sulphuric acid diluted with nine times its weight of water. The current was strong enough to almost immediately melt the insulating discs of a Foucault apparatus. The *thermhéliometre* was placed level with the carbon points, and the black thermometer at a distance of 0·395 m.; a difference of 3·63° between the temperature of the inner and the black thermometer was noted after an hour's observation. The heat of the carbon was estimated at 3000°. The temperature produced by the sun was next observed: the time of the day and month, noon, July. Taking the mean of various readings, and correcting them for errors due to absorption by the atmosphere, the temperature 21·13°, against 3·63° produced by the electric pile, was accepted as most correct. These quantities inserted in the equation—

$$I_s = I_c \frac{\theta_s \tan^2 \alpha}{\theta_c \tan^2 \delta}$$

gave 133,780°, in which $I_c = 3000°$, $\theta_s = 21{\cdot}13°$, $\theta_c = 3{\cdot}63°$, α and δ = diameters of the radiating surfaces of the carbon points. This result is much lower than those arrived at by either Newton's or Dulong and Petit's laws. This temperature of the sun's surface is only a few thousand degrees, and its cooling, though very slight, would, in a short interval of time be apparent by a notable acceleration of rotation which has been already observed.

No. 12.

Note on Magnetism, Continued (pars. 61 and 62).—M. Gaugain.—Let us designate by x the remanent magnetism which the current i developes, and by y the remaining magnetism developed by the current $+I$, after the passage of current $-i$. Let us admit, besides, that each of these magnetisms exercises, in presence of the other, the same action as if alone (a supposition justified by experiments), then we have $(y+x)=m''$, and $(y-x)=\pm m'$; from which the values of x and y may be ascertained. Again, since y represents the portion of the persistent magnetism (*magnétisme positif*) which remains after the passage of the current $-i$, the portion destroyed by that current $=m-y$. If a series of different values be given to I (i always remaining the same), then $m-y$ will represent the quantities of magnetism developed by the different currents I in a layer of the same thickness. On this principle several experiments were tried, and the results given, in tabular form, of values of $m, m', m'', x, y, m-y$. The values of x were found almost identical; those of $m-y$ all differed, and increased rapidly with the potential (*intensité*) of the current I; consequently, as this potential increases, so the magnetisation not only penetrates to a greater depth, but becomes stronger in the layer of the thickness e, to which the action of the weakest current employed is limited. This conclusion has reference only to remanent magnetism, but M. Gaugain thinks it probably true for the whole of the magnetism in the bar. — Par. 63. By magnetic *constant* he designates the magnetic state, established in a horse-shoe bar, when the armature has been attached and torn off for so many times that no further disruptions will weaken the polarity. This *constant* state depends, for a given electro-magnet, on the inducing current, and a multitude of conditions—*notably on the manner in which the armature is torn off the first time after the interruption of the inducing current.* The comparison of the values of constant magnetism, corresponding with different values of the inducing currents, is not easy, because the above mentioned condition is difficult to fulfil. In experimenting, the author found that in this case one must distinguish when the current m' is positive or negative, as, when negative, the value of x remains almost constant, but when positive it varies with the intensities of I and i. When I is not much greater than i, x is not notably smaller than what will represent the magnetism developed in a neutral bar by the current i; but if I be gradually augmented (i being constant) x diminishes in proportion, and will become $=0$ when I reaches a certain limit. Several experiments (m' being always negative) were carried on, in which i is constant and I increases, from which, reasoning similarly as in paragraphs 61, 62, the author concludes that when the potential of the inducing current is gradually increased, the magnetisation is made to penetrate to greater depths without rendering it considerably stronger in the layer of the thickness e, to which the action of the weakest current used is limited.

On the Magnetisation of Steel.—M. E. Bouty.—Reserved for future translation.

Calorific Effects of Magnetism in an Electro-Magnet of Several Poles.—M. A. Cazin.—Reserved for future translation.

Les Mondes. Vol. xxxiii., No. 12, March 19, 1874.

Aurora Borealis of the 4th February, 1874.—At the French Meteorological Society, M. Sainte Claire Deville stated that there are evidently recurring periods for these phenomena. M. Tarry mentioned that M. Sureau, director of the telegraph office of Nantes, observed the aurora of February 4th, 1874, in that city, and that he had been warned several hours before its appearance by magnetic currents appearing on the telegraph lines, especially those running east and west. In 1871 and 1872, M. Sureau devoted himself to some very interesting observations of these magnetic currents which *precede*, accompany, and follow auroras. At Brest he was successful in prognosticating the approach of some auroras. With regard to the particular aurora in question he observed, from five o'clock in the evening, the precursory signs of a magnetic storm on his galvanometer, and he prepared to study the magnetic waves indicated by the needle. The storm lasted from 7.20 p.m. to 7.55 p.m., and during the whole of that time he watched its approach and departure.

Electrolytic Pile.—L. Maiche.—Called electrolytic because the current is due to the decomposition of water. This element consists of an amalgamated zinc plate, a plate of rolled iron, and a solution of water acidulated with a tenth part of its own weight of sulphuric acid. The elements are arranged in a case capable of holding 20 or 30 troughs, above which are suspended the plates fixed to a frame, so that when the battery is required for use, the lid is closed, and the plates are simultaneously immersed. For certain practices which do not require a high potential, all the couples are joined in a still more simple manner. A large case encloses the acidulated water, another smaller case, whose bottom is open all its length to allow passage for the solution, receives all the plates placed alternately, and joined so that between the iron of one couple and the zinc of the next following are placed the zinc of the couple which precedes, and the iron of that which follows, forming a double partition without any loss of room. On causing the smaller case to descend, the pile is in working order. This pile, the author says, is designed to obtain oxygen and hydrogen in their *nascent* states, and thereby to maintain electrical conditions constant and contrary for each plate relatively to the other. The theory of the pile M. Maiche propounds thus:—The zinc feebly decomposes the solution, whose oxygen, *negatively* charged, in uniting with the zinc abstracts from it some positive electricity, and releases negative electricity which flows along the surface of the zinc plate to the conducting wire. The iron comports itself otherwise; the disengaged hydrogen neutralises the negative current from the zinc, and thus, the author says, maintains the iron plate in a neutral state. In conclusion, he adds, "My pile is more constant than all others which I have tried. The plates remain clean, *which proves the absence of injurious deposit.* The current is due to the presence on the surface of the plates *to a bed of hydrogen and oxygen*, incessantly renewed, which produces the same effect as is noticed with plates of platinum employed for electrolysis." This new theory of the cause of the electric current we leave to the student's consideration.

No. 13.

Contains no papers of interest on electrical or telegraphic subjects.

Journal Telegraphique. Vol. ii., No. 27.

Telegraphic Legislation.—The continuation of a series of articles on special legislation for telegraphs in different states.

Graphite Powder Rheostats.—In his paper on "The Historical Department of the German Telegraph Exhibition" (see TELEGRAPHIC JOURNAL, vol. ii., page 147), Dr. Zetsche, without pointing out the source, speaks of rheostats of powdered graphite pressed into glass tubes used in Germany, since 1865, at intermediate stations, for regulation of the line resistances. M. Clérac, traffic manager to the French Telegraphs, mentions that this rheostat is a French invention, and was not used in Germany before 1866. That gentleman, towards the close of 1865, thought of using carbon pounded and compressed into glass tubes to replace in certain cases the resistance bobbins; and Professor Hughes, struck with the simplicity and economy of this invention, imported it into Germany the following year. Since then the powdered graphite rheostats have been perfected in France by the substitution of ebonite for glass, thereby simplifying the construction and increasing the constancy.

The Importance of a Rational Grouping of Elements in Electrical Applications.—M. Th. du Moncel.—Reserved for future separate translation.

Nature, Vol. ix., No. 230. March 26, 1874.

Scientific Results of the "Polaris" Arctic Expedition.—The extracts on magnetism and atmospheric electricity now given are from advance sheets of the report of the secretary of the United States Navy on the examination of those of the crew who were in the ship when she broke from the floe to which she was anchored. The information now afforded is certainly meagre, but "a detailed account will no doubt by and by be published, although we regret to see" much that is valuable has been lost. *Magnetism:*—The magnetic observations obtained were more complete than any others ever before made in the Arctic regions. The instruments supplied were:—One unifilar declinometer; one dip circle with Lloyd's needles; one theodolite; and several prismatic compasses. The observations on variation of declination were registered at Göttingen time, and were continued for five months: readings taken hourly. Besides these, three term days were observed every month, according to the Göttingen regulations; one of these term days corresponding with the day accepted by all the magnetic stations. Further, a number of observations were taken either with the theodolite or the prismatic compass. Whenever possible the dip was observed, and several sets of observations on relative and absolute intensity and of the moment of inertia were obtained. *Atmospheric Electricity:*—Special attention was devoted to the aurora borealis, which occurred frequently, but rarely showed brilliant colours,—never bright enough to produce a spectrum. One observer watched the magnetometer, another the changes in the phenomenon. *In no instance could* the least amount of *electricity* be detected in the atmosphere.

Journal of the Telegraph. Vol. vii. No. 6.
March 16, 1874.

Electrical Marine Signals.—The General Transatlantic Steamship Company has had under consideration for some months past plans for using electrical lights upon the steamers of this line. On the night of Thursday, March 5th, a party of gentlemen, including the officers of the *St. Laurent*, proceeded down the bay to witness the experiments with the new lights. The boats with the electrical marine signal lights were about six miles apart, yet the signals, when displayed, could be plainly discerned, and appeared to be but a short way off. It is now decided that these lights are to be used hereafter on the steamers of the General Transatlantic line, so as to lessen the risks incurred by sea travellers.

Notes and Queries.

CHROMIUM BATTERY—BETULIN.

Will some correspondent explain the chromium plate battery, its arrangement, and cost, viz., the chromium plates, and where they are to be obtained; also where I can purchase betulin, or stopping-off medium, as used by gilders in hot solutions?—ELECTRO.

City and Commercial Notes.

THE ordinary meeting of the German Union Telegraph Company will take place in Berlin on the 22nd inst.

The ordinary meeting of the Hamburg-Heligoland Telegraph Company is fixed for the 22nd inst., at Berlin.

The traffic receipts of the Eastern Extension, Australasia, and China Telegraph Company, Limited, for the month of March, 1874, amounted to £19,530, against £17,988 for the corresponding period of 1873, showing an increase of £1542.

The total traffic receipts of the Great Northern Telegraph Company have been, during March, 1874, 366,851 francs, and, in the corresponding period of 1873, 265,494 francs. On the European Lines: In 1874, 209,821 francs; in 1873, 148,157 francs. On the China and Japan Lines: In 1874, 157,030 francs; in 1873, 117,337 francs. Total receipts for three months ending March 31, 1874, 977,416 francs; corresponding period in 1873, 614,437 francs.

The Eastern Telegraph Company's traffic receipts for the month of March, 1874, were £31,899, against £33,572 in the corresponding period of 1873.

The receipts of the Submarine Telegraph Company for the month of March, 1874, amounted to £9010 3s. 9d. For the corresponding month of the preceding year they were £8447 5s. 9d.

The Cuba Submarine Telegraph Company's cable between Batabano and Santiago de Cuba is now open for the transmission of telegrams. Telegraphic communication is thus re-opened with the whole of the West Indies, and Panama for the first time is placed in telegraphic communication with Europe.

The report of the Eastern Extension, Australasia, and China Telegraph Company, Limited, submitted to the first ordinary general meeting, held yesterday at the City Terminus Hotel, Cannon Street, shows that the total earnings of the Company for the year ending 31st December, 1873, amounted to £223,323 12s. 6d., the working expenses to £48,992 12s. 9d., and the repair and maintenance of the cables to £14,116 11s. 1d. Interest on debentures and income tax have absorbed a further sum of £3239 9s. 7d., leaving a balance of profit for the year of £156,974 19s. 1d. Three interim dividends of 1½ per cent each, aggregating £89,887 10s., have already been distributed, and there now remain £67,087 9s. 1d. for appropriation. The directors now declare a further dividend of 2 per cent, free of income tax, making a total of 6½ per cent for the year, which will absorb £39,950, leaving a sum of £27,137 9s. 1d., which will be carried to the reserve fund, thereby raising it to £41,554 10s. 4d. The debenture debt, which at the commencement of the year amounted to £17,100, has been reduced to £13,100, by taking up the bonds as they became due.

Referring to telegraph securities, in his circular of the 1st inst., Mr. W. Abbott says:—"With the exception of the decline in the value of Anglo-American Stock, quotations in this market have moved in sympathy with the depression recorded in almost every other department of the Stock Exchange. A firmer tone begins at length to be noticeable, and there is little doubt that on the return of confidence and activity in the markets generally, the Shares of the various Telegraph Companies will be largely benefited. The principle of quarterly dividends, so wisely adopted by the directors of these undertakings, aided as it is by the small denomination of the shares, as well as by the high interest yielded on the purchase cost, attracts a continuous stream of small investments of a non-speculative character, and this class of buying will ere long tell considerably on values, for it must not be forgotten the Telegraph Market is comparatively a limited one, as the total amount of capital invested in Submarine Cable Shares does not exceed about twenty-millions, or, say, one-third less than the amount of the Ordinary Stock of the London and North-Western Railway. Telegraph property, however, daily receives fresh support through the prospective opening of new lines tapping districts of great value. For example, the Brazilian line, when completed, will bring the whole of the South American continent into instant communication with Europe, an event which must give to the entire capital invested in Telegraphs a new impulse and an augmented intrinsic value. The opening of the Brazilian Cable will also add very largely to the commercial traffic on the Eastern and Western lines. The various produce markets of the world have now become so dependent upon each other that fluctuations of values at one place are daily necessitating an interchange of intelligence between all others; thus, had the Brazilian line been opened in the past month, the recent collapse in the Coffee Market on this side would alone have led to a considerable amount of extra traffic on the new cable, as well as on the older lines between the markets of the Brazils and those of England, America, Ceylon, and other places in the East. In view of such facts, it is very satisfactory to know that the vessels of the Telegraph Construction and Maintenance Company, the s.s. *Africa* and *Kangaroo*, leave in about ten days to restore the Lisbon and Madeira section of the Brazilian line, and that the expedition for the more important work of submerging the last link between St. Vincent and Pernambuco will be dispatched early in May. The repair of the Cuba line, just announced, opening up the rich traffic of the West India and Panama system, is an event of importance, and as confirmatory of the remarks above, will especially benefit the Anglo-American lines through their working agreements with the Western Union system, which controls the entire traffic from Key West in Florida to Europe, *via* the United States. The recent declaration of an interim dividend of 1¼ per cent for the past quarter on Anglo-American Stock has, no doubt, been misunderstood. It may be well, therefore, to remind the proprietors that this payment on account of the profits of the year has been made in response to the wish, strongly urged upon the board at the last meeting, that interim quarterly dividends should be continued, irrespective of the final distribution at the end of the financial year. The reports just issued by the Trustees of the Share Investment and the Submarine Cables Trusts are of an eminently satisfactory character. The large purchase of certificates, amounting to £8,800 from the surplus profits of the latter, and the drawing of over £5000 in the former at £110—thus giving a bonus of about £33 on the present quotations—will give renewed confidence in this class of investment. London General Omnibus Stock has improved 3 per cent ex dividend. There is at length a decided prospect that the great drawback to this class of investment, viz., the peculations of the conductors, is about to be removed by means of the Electrical Recorder. This invention marks the time of the day of each journey, the pace the omnibus travels, the number of stoppages and their duration, and the number of passengers each minute. Thus a complete record of each journey will be taken, and practically, it may be said, the instrument registers a balance sheet against the conductor with which it will be impossible to tamper, as the record is taken by the aid of an electric current absolutely unfailing in its results.

TELEGRAPH SHARE LIST.

Amount per Share.	NAME OF COMPANY.	Amount paid up.	Closing Quotations.
£		£	April 13.
Stock	Anglo-American (Limited)	100	74¾—75¼
10	Brazilian Submarine..	All	7—7½
10	Cuba	All	7¼—7¾
10	Direct Spanish	9	..—..
20	Direct United States Cable	All	14—15
10	Eastern (Limited)	All	7½—7¾
..	Do., New	..	102—104
10	Eastern Extn. Australia and China	All	7⅞—8⅛
10	Globe Telegraph and Trust	All	6⅞—7⅛
10	Do., 6 per cent Pref...	All	9⅛—9⅜
10	Great Northern	All	9¾—10¼
25	Indo-European	All	15½—16½
10	Mediterranean Extension (Limited)	All	4—4½
10	Do., 8 per cent Pref...	All	11—12
10	Panama and South Pacific	2½	..—.. dis.
8	Reuter's..	All	11—11½
Stock	Submarine	100	210—220
1	Do., Scrip	All	1⅞—2⅛
10	West India and Panama	All	4¾—5¼
10	Do., 10 per cent Pref.	All	9¾—10¼
20	Western and Brazilian (Limited) ..	All	11½—12½
1000 dls.	West Un. U.S. 7 per cent 1st M.B.	All	105—107
10	Hooper's Telegraph Works	All	11½—12
50	India-Rubber and Gutta Percha ..	All	23—25
Cert.	Submarine Cables Trust	100	109—112
12	Telegraph Construction	All	30½—31½
100	Ditto Ditto 7 per cent Bonds	All	102—104

Patents.

1845. E. Tyer, of London. *Improvements in Electric Telegraphic Apparatus for Train Signalling on Railways.* Dated May 21, 1873.—The invention relates to improved electric telegraphic apparatus for train signalling on railways, and the specification describes improved arrangements of apparatus for giving angular motion to the indices, semaphore arms, or other visual signal employed in telegraphs for train signalling on railways. Also to improved arrangements of keys for transmitting and receiving signals on railways from one station to another. Also to improved arrangements for communicating in a train between one part and another. Also to improved arrangements of galvanic batteries for train signalling on railways.

1903. C. W. Cooke, of Surrey. *Improvements in Apparatus for Winding Electro-Magnets with Insulated Wires.* Dated May 27, 1873.—A sheave is placed upon the core on which the wire is to be wound, and upon this sheave is fitted a band like an excentric strap, so as to rotate thereon. This strap has arms carrying bobbins containing the insulated wire, so that by the rotation of the band the wire is wound on the core, the bobbins being provided with springs for regulating the tension. The wires pass from the bobbins over metallic guide pullies, so arranged that all parts of the periphery of the wire are in contact therewith. The end of the wire coiled on the core is connected to one pole of a battery, and the before-mentioned sheave is connected to the other pole, so that if the insulation of the wire should be imperfect at any one point, a metallic contact will be made between the wire and the guide pullies, when such defective part passes over the latter, and thus a current will be passed from the battery through the sheave, and the fault indicated.

1969. I. L. Pulvermacher, of Middlesex.—*Improved Constructions of Metal Plates, Positive and Negative, and in Methods of Attaching or Connecting Plates or Elements to Form Chains or Batteries for Medico-Electric and other Purposes; also in Appliances Connected therewith for the Application of Electric Currents.* Dated May 31, 1873.—This relates to various appliances for the generation or distribution of electric currents for medico-electric purposes.

2006. C. W. Siemens, of Middlesex. (A communication from Dr. W. Siemens and F. von H. Alteneck, of Berlin). *Improvements in Apparatus for Producing and Regulating Electric Currents, such Apparatus being particularly applicable for Electric Lighting.* Dated June 5, 1873.—This invention relates to apparatus for producing by mechanical power currents of electricity, applicable more particularly to the production of electric lights, and for regulating automatically the currents applied to produce such lights. For producing electric currents two or more magnetic poles or polar extensions hollowed out cylindrically are arranged round an iron cylinder, which may be polarised in the manner of a Siemens's cylindrical armature, and in the annular space between this cylinder and the poles outside of it is caused to rotate a cylindrical shell, on the periphery of which insulated wires are wound longitudinally in several separate coils. The wires of each coil are connected by contact makers successively as they rotate to two poles of the machine. As each coil is made to pass successively through the magnetic fields by the rotation of the shell, currents of electricity are caused to pass through its wires, and these currents can by means of suitable commutators be transmitted either continuously or intermittently through conductors connected to the poles of the machine. The magnets employed may be electro-magnets rendered active from any source of electricity or by the electricity produced by the machine itself. The contact makers are preferably rollers bearing on springs, so that before leaving contact with one string they make contact with the next, thereby avoiding or greatly diminishing the sparks produced at sudden breaks of contact. The cylindrical rotating shell may be of iron. For regulating the currents working electric lamps, the lamp is provided with two electro-magnets, one having a coil of small resistance in the circuit of the lamp, and the other having a coil of greater resistance in a shunt circuit. Each electro-magnet has an armature working a pawl against a ratchet wheel, connected by screws or otherwise to the stems of the carbon points, so as to cause these points to recede from each other when the electric current passes freely through them, and to approach each other when the current encounters resistance owing to their distance. By employing a weight or spring, or the weight of the carbon holder itself, one of the electro-magnets may be dispensed with.

UNITED STATES.

143,529. F. L. Pope, Elizabeth, N. J. *Electric Circuit and Device for Railway Signals.* Dated June 11, 1873.—This invention consists of a system of signals at each end of a rail section, controlled by relays, whose batteries are opposed so as to normally neutralise each other, the entrance of a train on the section short circuiting each battery and rendering the relays operative, each relay closing two breaks normally in circuit of its signal magnets, and displaying signal at each end of section. Shows method, also, of limiting electric rail circuit at switches.

143,597. F. Tommasi, Paris, France. *Hydrostatic and Electric Telegraph Cable.* Dated November 20, 1873.—One or more pairs of fine copper tubes enveloped with insulating material, and provided with pistons at each extremity, for transmitting hydrostatic pressure through the tubes alternately, are in connection with reciprocating armature levers of double electro-magnets at each end of the double line, in such manner that the hydrostatic impulses are given by the transmitting magnets, while the reciprocating pistons at the receiving station make and break local electric circuits. The cables may be used for electrical transmission, if desired.

143,694. S. C. Hendrickson, Brooklyn, E. D., N. Y. *Electric Railway Signal.* Dated December 26, 1873.—A signal disc revolved continuously in one direction by a motor. Movement controlled by two electro-magnets, each being in a circuit from opposite ends of a section. One circuit being closed, an armature is withdrawn from a pin on shaft of signal, allowing signal one-fourth revolution, when it is stopped by armature of second electro-magnet, which, operated from its end of rail section, permits another one-fourth revolution.

144,135. E. D. Pritchard, New York, N. Y. *Protection for Underground Telegraph Wires.* Dated September 4, 1873.—A trough or tube filled with layers of solid beds, having upon their upper surfaces continuous grooves for the reception of line wires, is provided at proper points with lateral chambers into which the grooves and wires turn from and return to the main trough upon short beds, alternate ones only of which are used as line beds, the others being removable, to afford access to the wires.

JUBILEE VOLUME OF POGGENDORFF'S ANNALEN.—That this valuable scientific journal has been for fifty years, without interruption, edited by the same author, printed in the same office, and published by the same house, is certainly a striking fact, and one that is unprecedented, we should think, in the history of literature. We are glad to see that some practical recognition is about to be taken of it; a number of the friends and *collaborateurs* of Johann Christian Poggendorff having resolved to relieve him of his labours for one volume of the *Annalen*, and to present this to him as a "Jubilee-volume," in honour of the occasion; an expression of congratulation, and hearty thanks for the important service M. Poggendorff has rendered to service. It was in March, 1824, that Prof. Poggendorff commenced his undertaking, the new serial being in part a continuation of the *Annalen der Physik* that had been edited by the Profs. Gilbert, of Leipzic, since 1799. During these fifty years a hundred and fifty regular volumes of the serial have appeared, with six supplementary ones; and perhaps few will be able to fully appreciate the amount of hard work here represented. We learn from the prospectus now issued, that 2167 authors have, at different times, contributed to the *Annalen*. There have been in all some 8850 memoirs and papers; and, from a list giving their distribution, we note that Rose has contributed 193, Rammelsberg 177, Poggendorff himself 152, Berzelius 112, Dove 104, Faraday 76, Brewster 67, Liebig, 56, &c. The translated memoirs of Regnault fill 696 pages, or more than one large volume; while those of Faraday occupy 1617, or more than two volumes. Arago, Becquerel, Biot, Fresnel, and many others might be named. On the high scientific character, and the well-earned popularity of the *Annalen*, among physicists all over the world, it is unnecessary here to dwell. The learned editor has carried out his undertaking with great sagacity and enterprise, and made the journal a powerful instrument in the advancement of that department of science to which it is devoted. In the branch of physics with which we have more especially to deal, the *Annalen*, from time to time, contains highly valuable original investigations. We hail with pleasure the announcement of the "Jubelband," and congratulate M. Poggendorff on the completion of so long a term of honourable service.